



# Combined Heat and Power



**E**PA's State and Local Climate Change Program helps build awareness, expertise, and capacity to address the risk of climate change at the state and local levels. The program provides guidance and technical information to help state and local agencies prepare inventories of greenhouse gas emissions, develop action plans to reduce emissions, and educate their constituents. By emphasizing the many economic and environmental benefits of greenhouse gas reductions, the program encourages state and local decisionmakers to implement voluntary measures to reduce their greenhouse gas emissions.

## District Energy Systems and Cogeneration

**D**istrict energy systems distribute steam, hot water, and sometimes chilled water from a central plant to individual buildings through a network of pipes. District energy systems provide commercial and residential space heating, air conditioning, domestic hot water, and industrial process energy, as well as sometimes cogenerating electricity in combined heat and power (CHP) systems. Urban areas, academic institutions, state hospitals and correctional facilities, industrial parks, military installations, and other campus-type facilities are best suited for district energy.

In high-density areas, district energy is usually more economical and energy-efficient than individual heating and

cooling systems. This holds true especially when district energy plants include combined heat and power. A 22-megawatt CHP campus energy system at the Massachusetts Institute of Technology meets approximately 95 percent of campus power, heating, and cooling needs while reducing the university's electric bills by \$5.4 million annually.

Combined heat and power plant efficiencies can reach 60-90 percent because they make use of heat that otherwise would be discarded in conventional electricity generation. The high efficiency of CHP relative to conventional power plants can help reduce greenhouse gases and air pollution. With effective policies to remove barriers to implementation, new CHP systems could reduce greenhouse gas emissions by more than 70 million metric tons of carbon equivalent (MMTCE) by the year 2010.

The United States has an estimated 5,800 district energy systems, providing 1.1 quadrillion British thermal units (Btu) of energy. More than 2,000 state institutional facilities in the United States use district heating and cooling systems. However, district energy systems currently operating in the United States supply less than 5 percent of the nation's heating and cooling load.

District energy systems and combined heat and power plants are much more common in Europe and Japan than in the United States. The European Union plans to double the share of combined heat and power in its overall power mix (currently 9

### BENEFITS OF DISTRICT ENERGY

- High efficiency.
- Flexibility to use a variety of fuels, including local energy resources and waste heat.
- Reduced emissions of greenhouse gases, air pollutants, and ozone-depleting refrigerants.
- High reliability.
- Reduced capital, operating, and maintenance costs for building owners.
- Increased space in buildings because no internal heating or cooling plant is needed.
- Helps make downtowns more attractive for development.
- Energy dollars are spent within communities.

percent) by the year 2010. Combined heat and power already accounts for 40 percent of Denmark's power production.

Studies by the International District Energy Association suggest that new district energy systems and implementation of CHP in existing district energy systems could reduce fuel consumption by 1.6 quads and reduce carbon emissions by more than 50 MMTCE by the year 2020.

## The Federal Role

Although no federal programs are designed solely to support district energy, the U.S. Department of Energy and U.S. Environmental Protection Agency support district energy through their cogeneration and steam programs.

In December 1998, DOE launched the CHP Challenge program to remove institutional, regulatory, and market barriers to expanded use of combined heat and power. The goal is to double the U.S. cogeneration capacity by 2010, to a new total of approximately 100 gigawatts. The CHP Challenge program works with federal and state agencies, private organizations, and trade groups to raise awareness of the energy, environmental, and economic benefits of combined heat and power, including its use in district energy systems. The CHP Challenge has awarded grants in California, Indiana, Vermont, and Washington. The program also is working to expand the use of CHP in government facilities by working with the Federal Energy Management Program and facilities management agencies.

The U.S. Environmental Protection Agency also is involved in the CHP Challenge. EPA is focusing on environmental permitting issues such as output-based emissions standards for CHP systems and the inclusion of CHP as a strategy in State Implementation Plans (SIPs) under the Clean Air Act.

The second initiative is DOE's Steam Challenge program, a public-private effort developed in partnership with the Alliance to Save Energy and leading providers of energy-efficient steam technologies. The Steam Challenge program helps industrial customers retrofit, maintain and operate their steam systems (including district energy systems) more efficiently and more profitably.

## State Experience with District Energy

Many state and municipal facilities use district energy systems. States with programs to support cogeneration include California, Connecticut, Florida, Iowa, Massachusetts, Michigan, Nebraska, New Jersey, New York, Rhode Island, Texas, Utah, and Washington.

### Minnesota

In the early 1980s, the City of Saint Paul and downtown building owners established a private nonprofit corporation (District Energy St. Paul, Inc.) to develop a hot water district heating system. District Energy St. Paul subsequently developed a district cooling system and installed a 900-kilowatt cogeneration plant.

District Energy St. Paul serves 141 downtown buildings, including offices, hotels, government buildings, hospitals, an industrial park, and a 298-unit townhouse development.

A 25-megawatt biomass-fired cogeneration plant, expected to become operational in 2001, will supply more than 75

percent of the thermal energy required by the district heating and cooling systems. The electricity will be sold to Northern States Power. The \$52 million biomass-fired cogeneration plant will consume an estimated 275,000 tons of wood waste annually and will displace 110,000 tons of coal per year. The project will reduce sulfur dioxide emissions by some 600 tons per year and fossil fuel CO<sub>2</sub> emissions by an estimated 280,000 tons annually.

### California

The University of California Los Angeles' Energy Services Facility serves 13.5 million square feet of campus space with a combined heat and power system fueled by a mixture of landfill methane and natural gas. The system provides steam district heating, chilled water district cooling, and electricity to more than 100 campus buildings, including teaching and research facilities, a major teaching hospital, a sports arena, and other facilities.

The use of landfill methane reduces greenhouse gas emissions from the landfill and displaces natural gas that otherwise would be burned in the power plant. The plant meets strict California standards for nitrogen oxides (NO<sub>x</sub>) emissions and eliminates the need for more than 20,000 pounds of fluorocarbon refrigerants. The energy services facility has reduced the amount of electricity that UCLA purchased from the Los Angeles Department of Water and Power by 85 percent.

## For More Information

The U.S. Department of Energy's *CHP Challenge* aims to accelerate the use of cogeneration.

Website: <http://www.oit.doe.gov/chpchallenge/>

DOE's *Steam Challenge* program helps industrial customers improve the efficiency and profitability of their steam systems.

Website: <http://www.oit.doe.gov/steam/>

The *District Energy Library*, operated by the University of Rochester, provides a wide range of information on district energy and cogeneration.

Website: <http://www.energy.rochester.edu/>

The *International District Energy Association* provides information on district heating, cooling, and cogeneration.

Website: <http://www.districtenergy.org/>

The *U.S. Combined Heat and Power Association* is a nonprofit association that supports cogeneration.

Website: <http://www.nemw.org/uschpa/>

EPA's *State and Local Climate Change Program* helps states and communities reduce emissions of greenhouse gases in a cost-effective manner while they address other environmental problems.

Website: <http://www.epa.gov/globalwarming/> and click on "Public Decision Makers" under the "Visitors Center."